

# The Design of Pre-Modern Indigo Vats in North India : A Study of Seventeenth and Eighteenth century Indigo Vats of Bayana and Kol Indigo Tracts

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# The Design of Pre-Modern Indigo Vats in North India : A Study of Seventeenth and Eighteenth century Indigo Vats of Bayana and Kol Indigo Tracts

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**I**ndigo, a dye-yielding crop was a much favoured commodity in the Mughal Empire during the seventeenth century. Abul Fazl mentions it in all the *zabti* provinces of the empire:<sup>1</sup> its cultivation spread from Sehwan in Sind<sup>2</sup> to Telangana in the Deccan.<sup>3</sup> Tavernier lists places like Khandesh, Golconda, Burhanpur, Bengal and Bihar apart from Bayana, Hindaun, Khurja and Sarkhej where indigo was sown and produced. According to him, the indigo coming from various localities of the empire, was of 'various qualities, which increase or diminish' its price.<sup>4</sup> However it appears that the most important indigo producing centres were the Bayana tracts in the environs of Agra; the Kol (modern Aligarh) and Khurja (district Bulandshahr) region in the Doab and the Sarkhej tract in Gujarat. The best indigo was produced in Bayana<sup>5</sup>; that of Sarkhej was considered the second best.<sup>6</sup> The indigo produced in the Kol (Aligarh) — Khurja tract was of a lower quality as compared to that of Bayana.<sup>7</sup> According to a Factor at Agra:

Not that the kind made on the other side of the river of Coaria [Khurja (?)], Coule [Kol], Jellaly [Jalali], and other places, is absolutely useless; but it is not to be compared with the Biana product, as is shown by the difference in price, which is usually 5 or 6 rupees per mound.<sup>8</sup>

However, if we believe Tavernier, the quality of Bayana and Khurja indigo was quite comparable:

In the first place some [indigo] comes from the territory of Biana, from Indoua [Hindaun?], and from Corsa [Khurja], one or two days march from Agra; this is considered to be the best of all.<sup>9</sup>



In fact, one factor writing in 1648, declares the Khurja indigo to be of a superior quality as compared to that of Gujarat (the Sarkhej tract). It is quite interesting to note that the superiority derives from the technique employed in manufacturing the indigo at Khurja.<sup>10</sup> Pelsaert on the other hand maintains that the superiority of the Bayana indigo was due to the 'brackish water in the wells near the town' while the sweet water made the 'indigo hard and coarse'.<sup>11</sup>

However with the introduction of indigo production in the British and French colonies and partly also owing to the inferior quality of the Indian product resulting from systematic adulteration resorted to by the local producers, the demand for Indian indigo in Europe had declined drastically during or after the 18th century. These factors were, perhaps, also responsible for the total disappearance of indigo production from Bayana by the end of the 18th century and the end of 19th century from Jalali and Khurja. If we believe Watt, then despite the partial revival of European market and with all the encouragement given by the government to indigo production in general, the cultivation and manufacture of indigo in Bayana could not be subsequently revived.<sup>12</sup> So much so that at present, the people of Bayana, Jalali and other places know almost nothing about indigo manufacture for which these places were so famous during the 17th and 18th centuries. In the minds of the local people a faint memory of indigo production of two hundred years back survives only in the form of popular identification of certain spots as *nil ka kuan* (indigo-well), *nil ki kothi* or *nil ka kunda* (indigo-tank).

This paper attempts to make a study of the technique of indigo production in the Bayana and Kol tracts of the seventeenth and eighteenth century. The study is based on a comparative study of the information contained in the contemporary sources and the physical remains of the indigo 'factories' (or *kothi*) which survive at various places in Bayana, Aligarh and Khurja.<sup>13</sup> A preliminary report of a survey of indigo vats in Bayana<sup>14</sup> and their comparison with the information provided by Pelsaert has already been published.<sup>15</sup>

A perusal of the sources indicates that there was more than one method to extract indigo from the plants.

Linschoten is one of the first to describe the making of indigo at Cambay. Writing about 1594-96 he remarks:

[it] is sown like other hearbes, and when [time and] season serveth, pulled and dried, and then is made welle and beaten, and so certayne dayes after dried againe, and then prepared. At first it is a fine greene, but after it is a fayre blew...<sup>16</sup>



This 'dry leaf' method however is referred to in the context of indigo manufacture in the Sarkhej region only and is also mentioned by Mandelslo and Geleynssen de Jongh.<sup>17</sup> According to de Jongh, as per this method, the leaves were sun-dried and then shaken off from the twigs and kept in a vat for 4 to 5 days. The soaking of the colour in water within the vat was further facilitated through repeated stirrings and beatings. The rotting leaves and the dye-soaked water were then shifted to another tank where it was let to remain for one or two days to let the heavy pigments of the dye to settle down. The clear water from the top was removed and the residue with the pigments was then strained and let to dry in the sun and ultimately cut into pieces.

Joseph Salbancke visited Bayana in 1609 and his is the earliest eye-witness description of the technique of manufacturing and extracting indigo at Bayana. According to him, in the 'Indico milles' the plants after being cut

... lyeth on heapes for halfe a yeere to rot, and then by oxen it is trodden out from the stalkes, and after wards is ground very fine, and then boiled in furnaces, and so sorted out into severall sorts.<sup>18</sup>

This 'dry-leaf method' is significantly not mentioned by any other contemporary traveller as far as North India is concerned.

The popular method employed in all the indigo tracts appears to be the 'wet-leaf' method in which the stalks and leaves of the indigo plant were soaked to extract the dye. However this method had two variants: the single vat system and the two-vat technique. We have the testimony of Pelsaert that the first technique was prevalent in the regions of Mewat and Sarkhej, while the second prevailed in the Bayana and the Kol-Khurja tracts:

The method of manufacture [in Mewat] is that of Sarkhej rather than Bayana; the steeping of the plant, and the working back and forward to extract the dye from the leaves are done in a single *put*, whereas in Bayana or Gorsa [Khurja] two are used...<sup>19</sup>

Tavernier is much more detailed when he explains this single-vat system in Gujarat. According to him:

The tanks are generally from 80 to 100 paces in circuit, and when half-full of water, or a little more, they are filled up with the cut plant. The Indians mix it and stir it up with the water every day until the leaf — for the stem is of no account — becomes reduced into slime or greasy earth. This done, they



allow it to rest for some days, and when they see that all has sunk to the bottom and that the water is clear above, they open the holes made round the tank to allow the water to escape. The water having been drawn off, they then fill baskets with the slime, after which, in a level field, each man sits near his basket, takes this paste in his fingers, and moulds it into pieces of the shape and size of a hen's egg cut in two — that is to say, flat below and pointed above. But the indigo of Ahmadabad is flattened and made into the shape of a small cake...<sup>20</sup>

From the account of Peter Mundy it appears that the steeping and stirring of the stalks and leaves to extract indigo pigment took around 48 hours before the 'water receaves the Coulour'.<sup>21</sup>

This single-vat technique of manufacturing indigo was 'inferior' and resulted low quality of dye. This is specifically mentioned by a factor at Surat, who in 1648 wrote to Bayana:

...this sort will not come up to expectations as regards goodness; for it, being to my knowledge, made in one chebecha [*chāhbacha*] can not compare with what is made in Coriah [Khurja] itself.<sup>22</sup>

Thus from these descriptions it appears that in this system there were single circular vats called *chāhbachas*,<sup>23</sup> (artificial wells; lit. sons of wells) which were used both for steeping and beating purposes to extract the indigo dye from the plants.

Finch and Pelsaert on the other hand describe the two-vat system which prevailed in the Bayana-Agra-Kol region during the seventeenth century. According to their description, there were pairs of a rectangular and circular tanks or vats in which the indigo was processed to extract the dye. The stems and leaves of the indigo plant were first placed in a rectangular vat, the 'long cisterne' of Finch and the *put* of Pelsaert, where they were covered with water and steeped for a period of time: 16 or 17 hours according to Pelsaert; 24 hours according to Francis Fettiplace; 48 hours according to Mundy; or 'for certaine dayes' according to Finch.<sup>24</sup> This tank was 'well plastered' with lime to check any seepage<sup>25</sup> and had a depth of 'the height of an ordinary man'.<sup>26</sup> According to Pelsaert the yield of one *bigha* or '12 or 20 *ser* according to the yield' could be held by each of these *put* or vats.<sup>27</sup> The pressing of the steeped leaves and stalks of the indigo plant in these rectangular tanks was done by pressing the material 'with many stones'.<sup>28</sup> It was due to this that these rectangular tanks were also known as the 'steeping tanks'.

These steeping vats were connected to circular tanks or cisterns



which were situated at a somewhat lower level. After the 'substance of the herbe be gone into the water' as a result of steeping and stone-pressing, the mixture was transferred into these circular vats or tanks, which according to both Finch and Pelsaert had a small 'bowl-shaped' receptacle at its base.<sup>29</sup> Once transferred, two or three men standing inside the vat, either stirred the liquid with 'back and forth movement of their arms'<sup>30</sup> or stirred it with 'great staves, like batter or white starch'.<sup>31</sup> This beating and stirring continued from around 6 hours to 16 hours, all the while mixing 'a little oil' before letting it stand for a day or so to allow the heavy matter and pigments in the resultant blue water to settle below in the bowl-shaped receptacles.<sup>32</sup>

Lucas Antheunis, writing about indigo processing at Masulipatam on the other hand, informs about mixing of a particular fruit to bring the required thickness and hue :

Here is some very fine and good and may make it generally so but that in seething they mingle with it the rinds of certain fruit like green Spanish figs, which makes it heavy and takes away his colour more or less, according as they put thereof in.<sup>33</sup>

The clear water which was left at the top was then drawn out either manually or by 'opening holes made round the tank'.<sup>34</sup> The process of beating, stirring and settling was repeated till 'only a thicke substance' remained. According to Pelsaert there was 'an outlet at the level of the bottom' of the circular beating vat through which the remaining water was drained.<sup>35</sup>

The wet pure indigo which had sunk to the bowl-shaped receptacle was now collected and taken out to be dried. According to Pelsaert, the bottom of the vat was spread with ashes 'to form a crust'<sup>36</sup> and probably help in easy removal of the indigo.

The drying of the indigo was in two stages: first the substance was poured on a cotton cloth spread on the ground so that the extra water was soaked by the soil; and then the semi-dry indigo was then shaped by hand or cut into balls or cakes and kept for further drying on the sand. Ultimately the dry balls of indigo were then kept in earthen vessels which were closed tightly to prevent further drying due to sun and winds.<sup>37</sup>

As mentioned earlier, the explorations at Bayana were conducted in February-March 1985, and again in April 1986. Several sites were to be found in the neighbourhood of Bayana, and at seven places remains of pre-modern indigo vats were actually located. In the light of the history of indigo manufacture and its technology briefly noticed above, we can safely ascribe the remains we encountered to the 18th century or earlier. The sites where indigo vats were found are: (1) Damdama, 3 kms north-west of



Bayana; (2) Khau Kuan, Sikandra, 3 kms south of Bayana; (3) Bundela Ka Kuan, Sikandra, 3 kms. south of Bayana; (4) Nil Ka Kuan, Maurda, 15 kms north-west of Bayana, (5) Nil Ka Kuan, near Khirki Wala Darwaza, Wer (*tehsil* headquarter situated in  $27^{\circ}1'N$ , and  $77^{\circ}11'E$ .); (6) Brahmbad, 7 kms north-east of Bayana; (7) Chapcha Ka Kuan, Bhagori, 9.5 kms north-west of Bayana (on road to Bhusawar).<sup>38</sup> All the vats are constructed using the rubble stones and lime mortar.

At Jalali, where the explorations were conducted in June 1984 and May 1985, eleven sites were located and surveyed of which three were 'modern' (19th Century) and the others 'medieval' or pre-18th century. Amongst these sites were (1) Garhi Naddi, (2) Parshadi ka Bagh, (3) Nagla Mahdi Ali, (4) Jaddi ka Bagh, (5) Nagla Nayabas, (6) Idgah, (7) Sibtain Miyan ka Bagh, (8) Khera Ukarna, (9) Yasinwala Bagh, (10) Karbala, and (11) Village Chamrauli.<sup>39</sup> Here the material of construction is lime mortar and bricks. The mean size bricks is  $0.18 \times 0.10 \times 0.03m$ .

The indigo vats at Shahpur Kothi, Madrak, are also constructed with the help of bricks. The mean size of the brick used in the lower layers of the pre-modern vats is  $0.17 \times 0.10 \times 0.03m$ . Large British bricks with kiln markings are used in the modern vats.

The structures of the vats found at the surveyed sites conform largely to the description given by Pelsaert. Each one of them consists of two tanks: one rectangular and the other circular, placed side by side but at different levels. These are connected with each other by a narrow channel level with the base of the rectangular tank and going over the top of the circular one thus facilitating the flow of liquid from the former to the latter.<sup>40</sup> This entirely agrees with the design described by our sources, especially Finch and Pelsaert. However the shape of the mouth of the channel at Bayana and Jalali significantly differs from each other. At Bayana it protrudes from the wall while at Jalali the projection is absent.

The water is brought to the vat in a channel commencing at a well close by. The bed of this channel is always elevated so as to allow the water to flow into the rectangular tank from the top of its parapet. Although on this point both our authorities are silent, entry of water into the rectangular tank through a channel atop its parapet is clearly implied.

There is a significant confirmation of Pelsaert's description of the indigo vats at Bayana. The average perimeter and depth of the rectangular tanks as also the average circumference and depth of the circular tanks comprising the vats surveyed at Bayana approximate roughly to the measurements given by Pelsaert.<sup>41</sup>



A close examination of two of the circular tanks at Wer and four each at Brahmbad and Jalali for examining their inner structures confirmed contemporary description on two further counts. At the bottom of each one of them there is at present 'a bowl-shaped receptacle' for the dye 'to settle'.<sup>42</sup> There also exists, in each one of them in Bayana, an 'outlet at the level of its bottom' for allowing the water to run out. It is by joining together stone-pieces carrying semi-circular grooves that these outlets are created. In all the cases outlets are circular in shape and are very narrow, having diameters of about 8 cm. Narrowness of the outlets was possibly aimed at preventing a sudden rush of the liquid that could disturb the dye settled in the bottom. It also worth noting that invariably the outlets are level with the margins of the central bowls. This would suggest that when Pelsaert talks of outlet being at the level of the circular tank's bottom, he is obviously drawing a distinction between the bottom of the circular tanks and that of bowl-shaped receptacles in its centre. From this one may also imagine that the bottom of the circular tanks or the margin of the bowl-shaped receptacles would always be at a slightly higher level than the adjoining ground. But at the same time it was observed that a major part of the vertical lengths of bowl-shaped receptacles representing about 1/3 of the total depth of the circular tanks remained sunk into the ground.<sup>43</sup> Apparently, this design was adopted deliberately to prevent the top of the parapets of the rectangular tanks from attaining a height that might have been considered inconvenient for lifting water. But then this is true only for the vats at Bayana.

At Jalali on the other hand, in none of the eleven sites does one encounter these internal outlets. It appears that at least at Jalali the water was manually lifted out of the circular tanks. In the Indigo vats at Garhi Naddi and Jaddi ka Bagh, we encounter sprouted channels which were perhaps meant for manual lifting out the water from them. At Shahpur Kothi, Madrak, the circular vats could not be cleared to study their internal organisation. However, at this site the circular vats are entirely sunk in the ground, hence there is no possibility of an outlet on its floor. The water after precipitation and settling of pigments was probably drawn out with the help of buckets. Would this then suggest that the indigo vats at Jalali and Shahpur Kothi can be dated earlier than those of Bayana which are technically more advanced? Or was it no innovative feature at Bayana which is thus commented upon by Pelsaert, a feature not found outside the Bayana region?

There are, however, two additional features of the designs of



the circular tanks at Bayana which have not been recorded by Finch, Pelsaert, Peter Mundy or Tavernier. These deserve to be mentioned. Firstly, in the bottom of the bowl-shaped receptacle there exists yet another and smaller bowl which Pelsaert did not notice.<sup>44</sup> Secondly, it seems that the bowl-shaped receptacle had two standard designs. In some of the circular tanks it has almost vertical sides. This is, for example, the case at Brahmbad in the single vat located to the north of the well and also in the third vat from the west in the row of vats located to the east of the well. In some other cases those bowls have slanting sides giving them a somewhat conical shape. Examples of conical bowls are those of first and second vats from the west in the row of vats located to the east of the well at Brahmbad and those of second and third vats from the west at Wer.<sup>45</sup> The Jalali vats on the other hand had the regular 'bowl-shaped' receptacles with no second cup within.

In almost all the circular vats at Jalali and Shahpur Kothi an additional feature which we encounter, and which has escaped the attention of our chroniclers, is the presence of a grooved niche on the walls to help the workmen stirring the vats to enter or exit the vats. This feature is also seen in almost all the 'modern' vats as well.

Another peculiar feature we encounter is the fact that at a number of sites at Jalali, the depth of the rectangular and circular vats is not as has been mentioned by Pelsaert. According to Pelsaert the depth of the rectangular vats was generally 'the height of an ordinary man' and that of the circular vat '6 ft deep'.<sup>46</sup> At Naddi Garhi and Jaddi ka Bagh the rectangular vats are rather shallow, while at the Idgah, Jalali, both the rectangular and the circular vats are low and shallow. The rectangular tanks at Jaddi ka Bagh are 0.88 m deep and at Idgah the depth is 0.90 m.

A close examination of the floors of rectangular vats at a number of sites, both at Bayana and Jalali revealed that originally these had angular corners and were joined to parapets at right angles. But at some later stage, it was discovered that the angular sides and corners of the floors were prone to be damaged as a result of water seepage. This defect was sought to be remedied by super-imposing rounded layers of plaster all along the margins as well as vertically along the corners where the ramparts are joined to each other at right-angles. This may, for example, be observed at Wer, at Bayana at Garhi Naddi at Jalali. Further in most of the sites, especially at Jalali, the floors of the rectangular vats as well as the corners and the margins of the floors are made round with plaster to prevent water seepage. Water seepage



was further restricted by giving two layers of plaster in both the rectangular and circular vats. At Jaddi ka Bagh, Jalali, the second layer of plaster was 0.03 to 0.04 m. At Garhi Naddi and Jaddi wala Bagh, Jalali, there is added a round layer of plaster (0.10 m) along the circular edge of the floor in the lower tanks. This was not only to avoid seepage but also to facilitate easier gathering of the wet indigo from it.

Another very interesting insight is provided by the peculiar manner in which, some times, a vat or a set of vats, is sought to be joined to the masonry work of the rest of them located at the same site. This was noticed first at Wer where the third rectangular tank from the west is not properly joined to the parapet separating it from the rectangular tank of the second vat from the west. In fact, at the point where the front parapet of rectangular tank of the third vat meets the side parapet of the rectangular tank of the second vat, the plaster covering the latter is clearly visible. This should suggest that originally, at this site, there were only two vats. It was, perhaps, at some later stage, when a need for increasing the production capacity of the plant was felt, that a third vat was added hurriedly. It seems that while making this addition the mason did not care to remove the original plaster from that portion of the side parapet of the second rectangular tank where the front parapet of the third rectangular tank was joined to the existing structure. That is why joint at this point became faulty. It is, however, a clear proof of the fact that the third vat was added some time after the first two were completed. This feature recurs at Brahmbad, where out of the four vats that stand in a row to the east of the well, the first one was built earlier and the rest of them were added later. A closer examination of the photograph showing the eastern parapet of the first rectangular tank viewed from the north-east brings this out very well. In this photograph, one notices that the whole of this parapet, including the portion where it was joined by the northern parapet of the second rectangular tank, retains its original lime-plaster. Here it is worth mentioning that the thatched-roof over these structures and a rectangular gap in the northern parapet of the second rectangular tank are recent modifications for converting them into some sort of cattle-sheds. It is, therefore, obvious that the presence of lime-plaster over the whole stretch of the eastern parapet of the first rectangular tank cannot be explained with reference to this opening. Originally, this opening was not there and the northern parapet of the second rectangular tank was obviously joined to the eastern parapet of the first rectangular tank without removing its original plaster.



But, on the other hand, similar faulty joints are not to be found in the remaining three vats. From this it would follow inevitably that, originally, only one vat was built at this place. It was at some later stage that three more vats were added in the same line. On the strength of this insight, one might further conjecture that, at some stage, the indigo manufacture at Bayana had experienced a sudden impetus inducing the manufacturers to increase the production capacities of their plants considerably. If one goes by the Brahmbad plant, this increase would appear quite dramatic envisaging the expansion of the plant from one to four vats. One may guess that the indigo manufacture at Bayana could have experienced such an impetus, for instance, in the beginning of the 17th century when the European trading companies entered into the Indian manufacture market on a big scale. From Pelsaert's treatise one comes to know that it was during the first quarter of the 17th century that the Dutch East India Company became especially interested in the Bayana indigo.

Indigo vats to the north of the Idgah at Jalali too reveal an augmentation of production after initial constructions. Thus here a look at the joints in masonry point to two original sets of tanks to which a set of three vats were added at some later date. The original channel supplying water first was constructed in the north. Later with the extensions a new channel was added on the eastern parapet of the rectangular tanks.

Similar, and perhaps more forceful evidence is encountered at Shahpur Kothi, *tehsil* Kol near Madrak, district Aligarh : there are twelve pre-modern (set of rectangular and circular vats) along with four modern set 19th century vats. Both these sets are joined with a large circular tank whose plinth is presently at a height of 160 cms from the ground. An irregular shaped second tank connected to the large circular tank with an iron pipe is located towards the well. Channels connect these two tanks with the sets old and new indigo vats. This suggests that the pre-modern vats were still in use even after the construction of the 'modern' vats and together they constituted the Shahpur Kothi which produced indigo to meet the demand of the dye during the nineteenth century. □





Plate 1 (a) : Nilwala Kuan Wer, Bayana

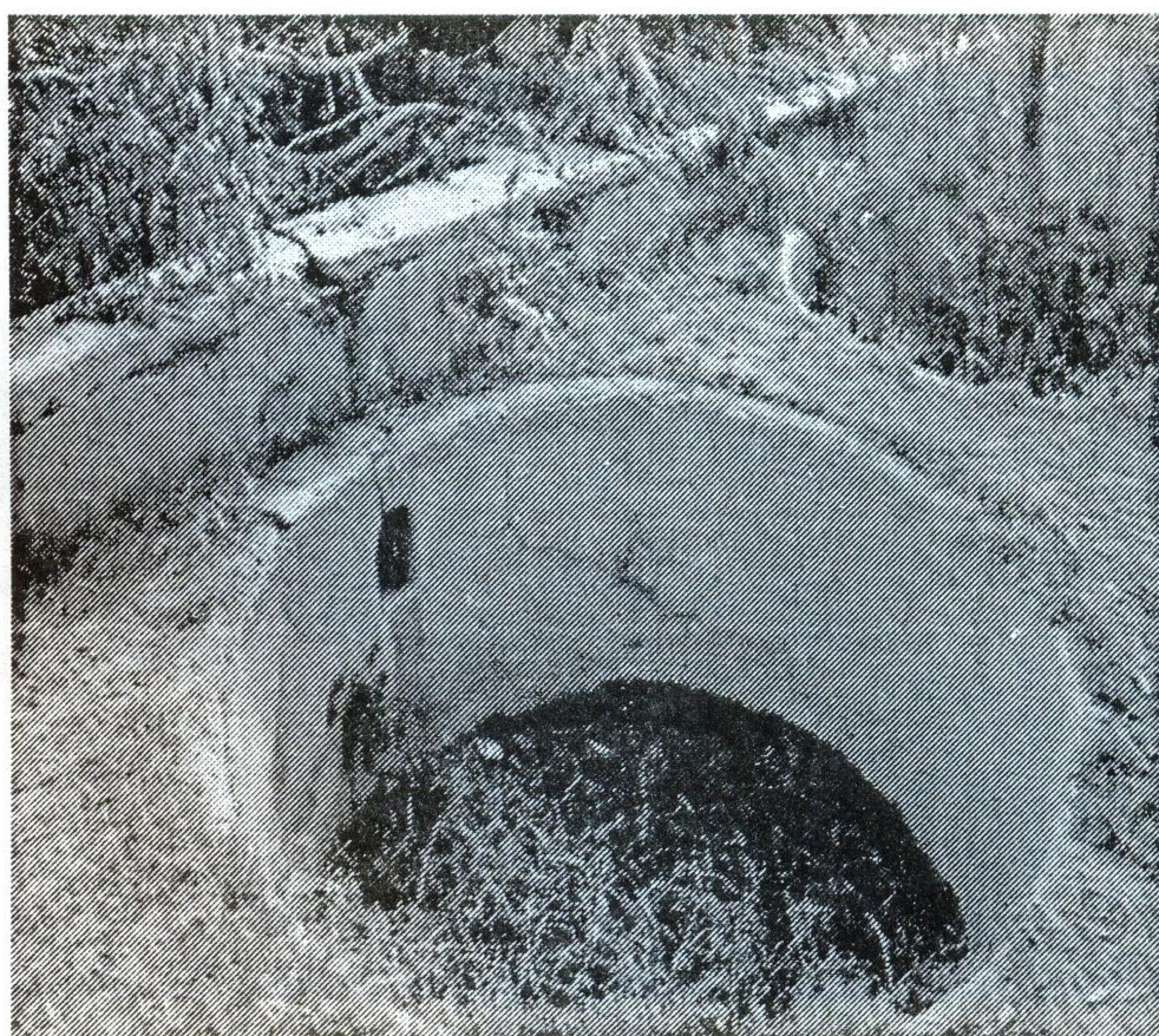


Plate 1 (b) : Naddi Garhi, Jalali



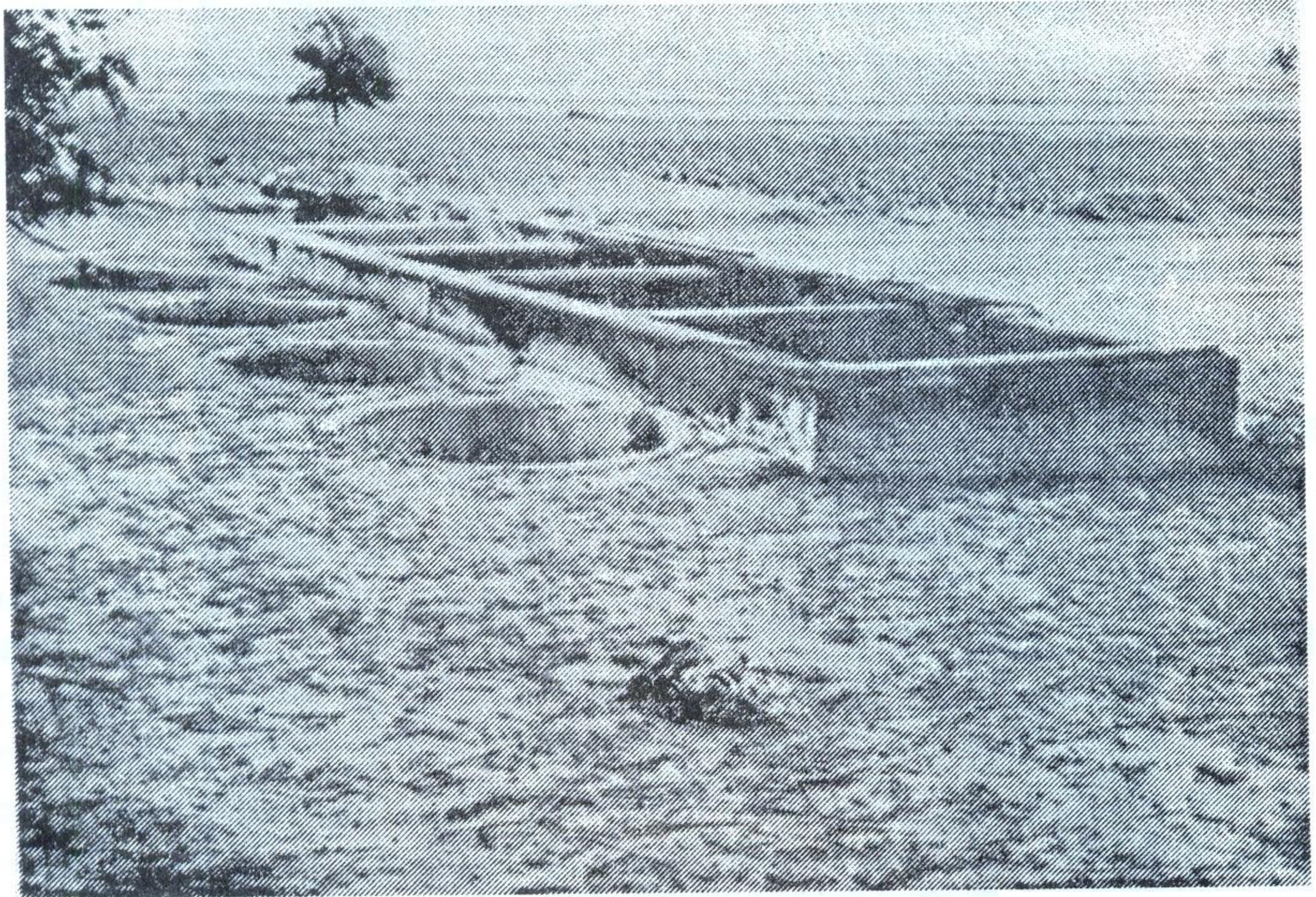


Plate 2 : Naddi Garhi, Jalali

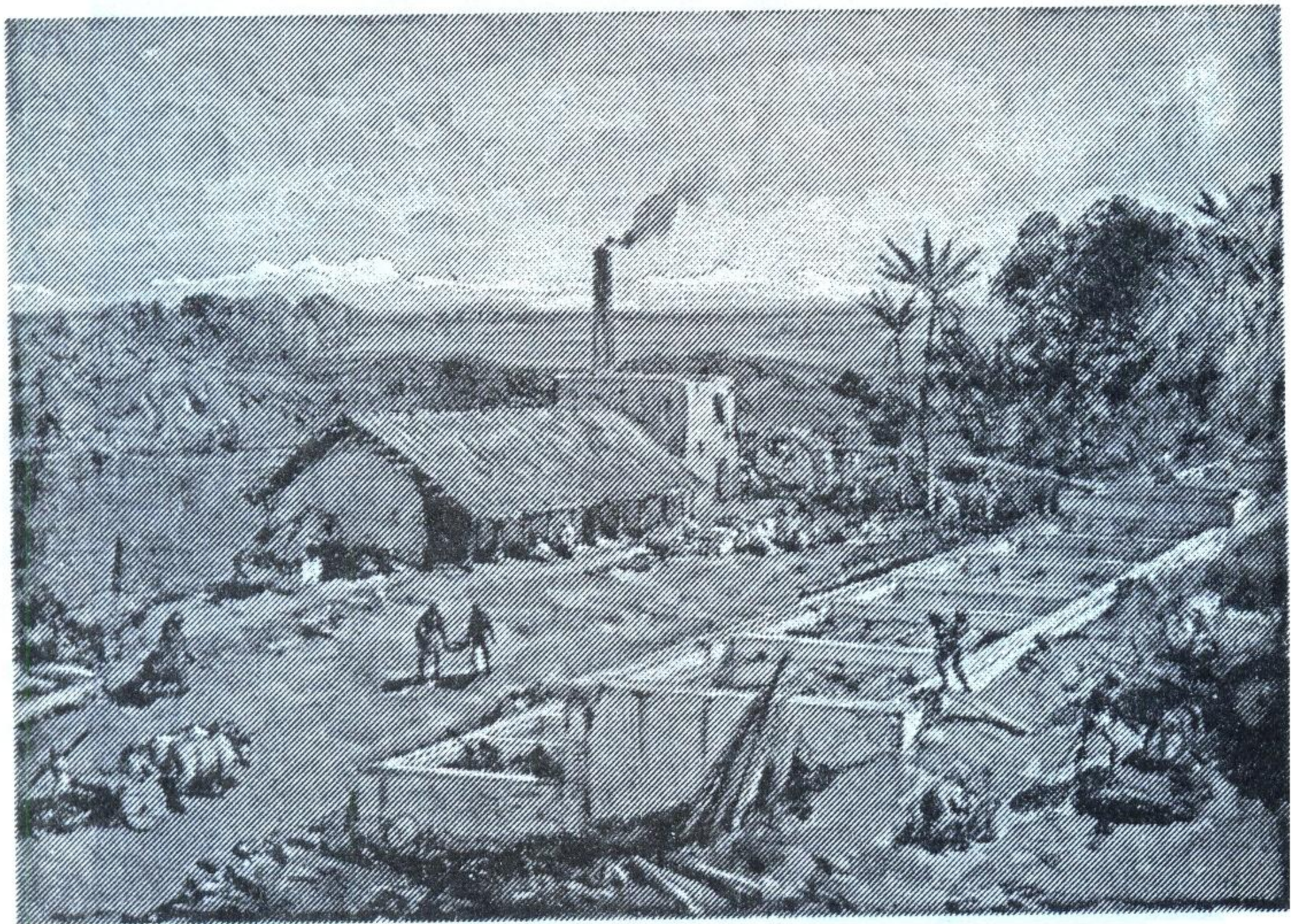
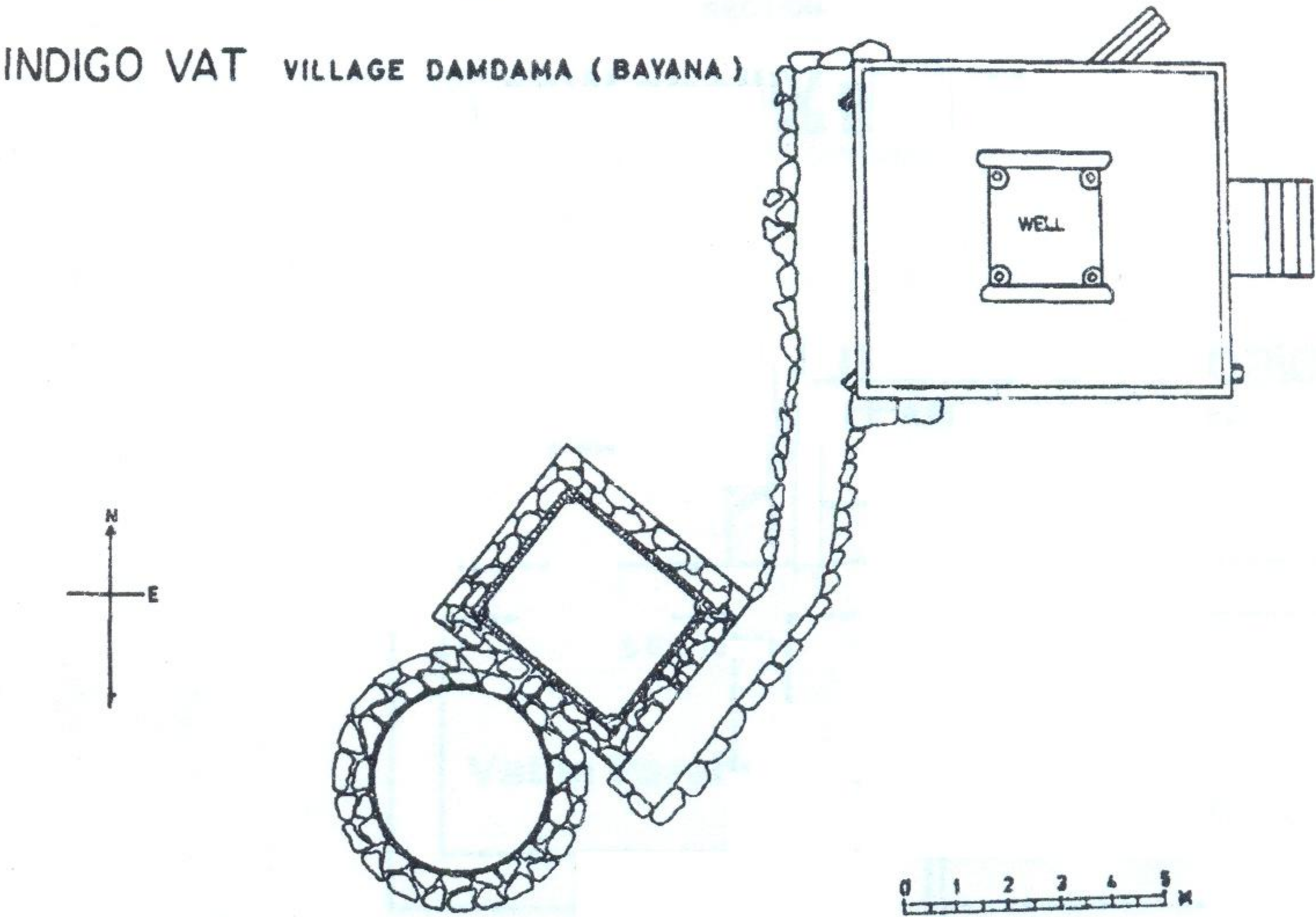
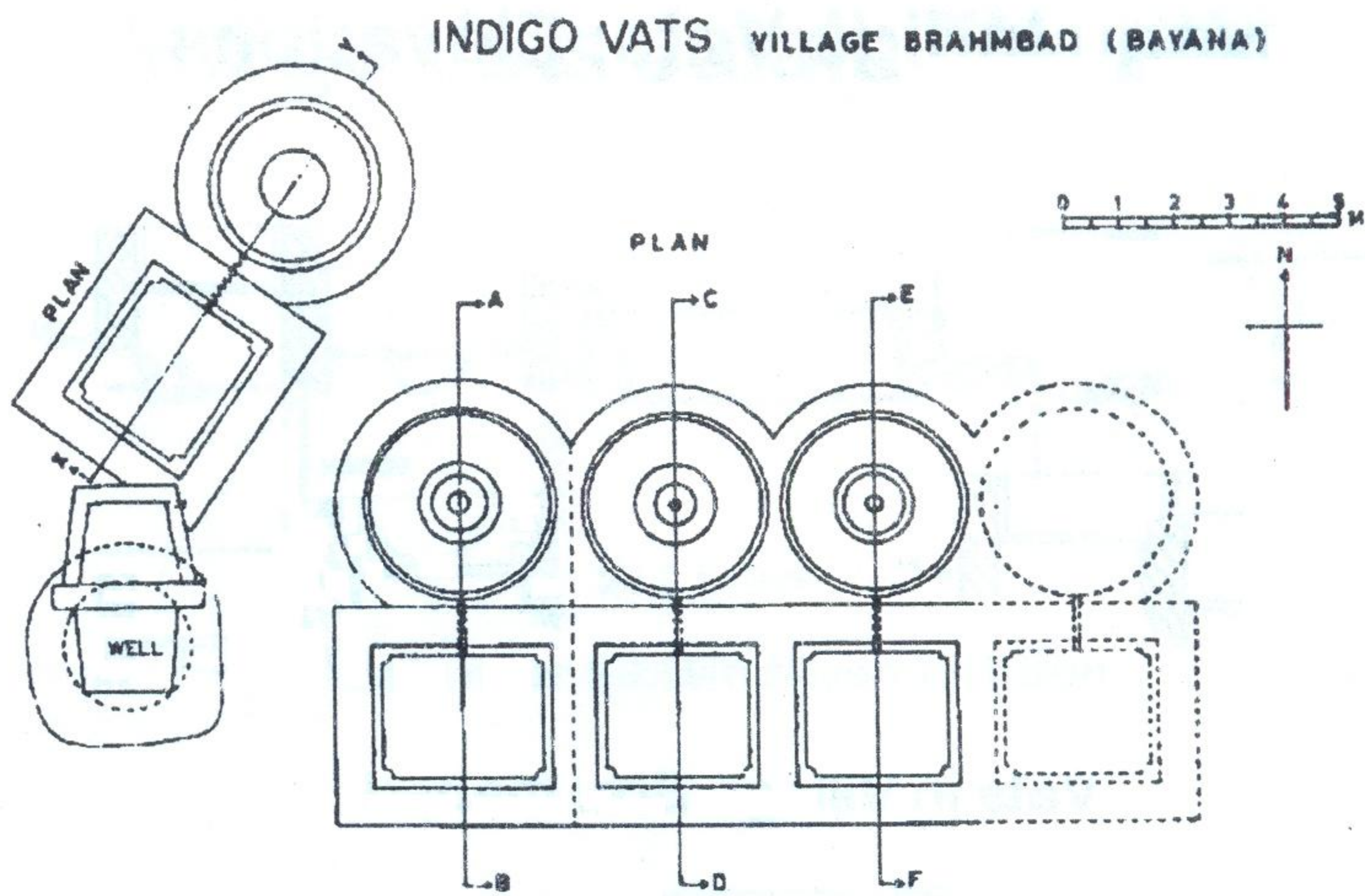


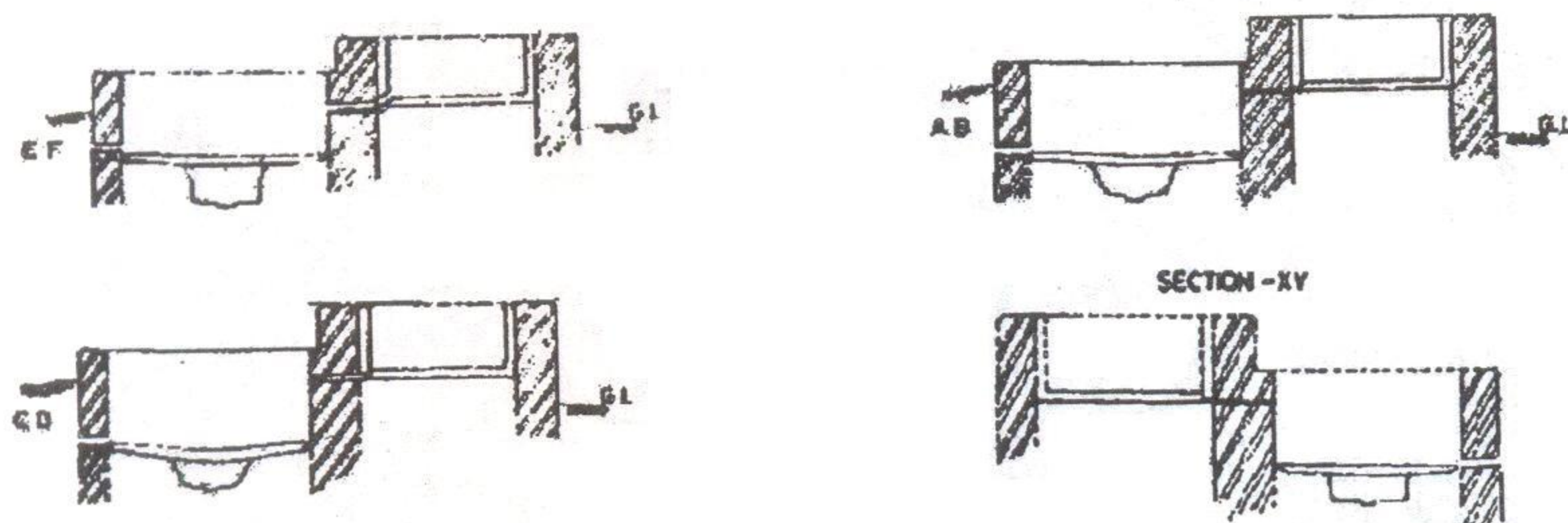
Plate 3 A Modern Indigo factory, Bengal, 1863



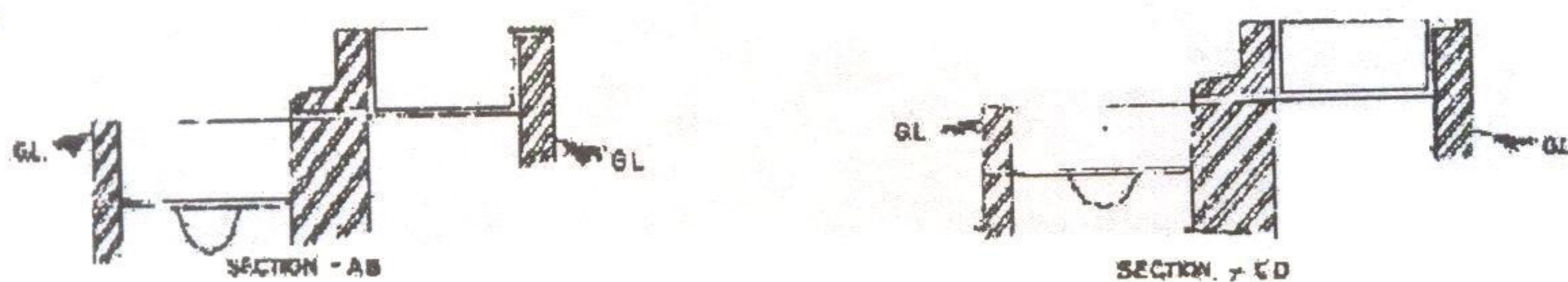




## Bayana Indigo Vats: Elevations

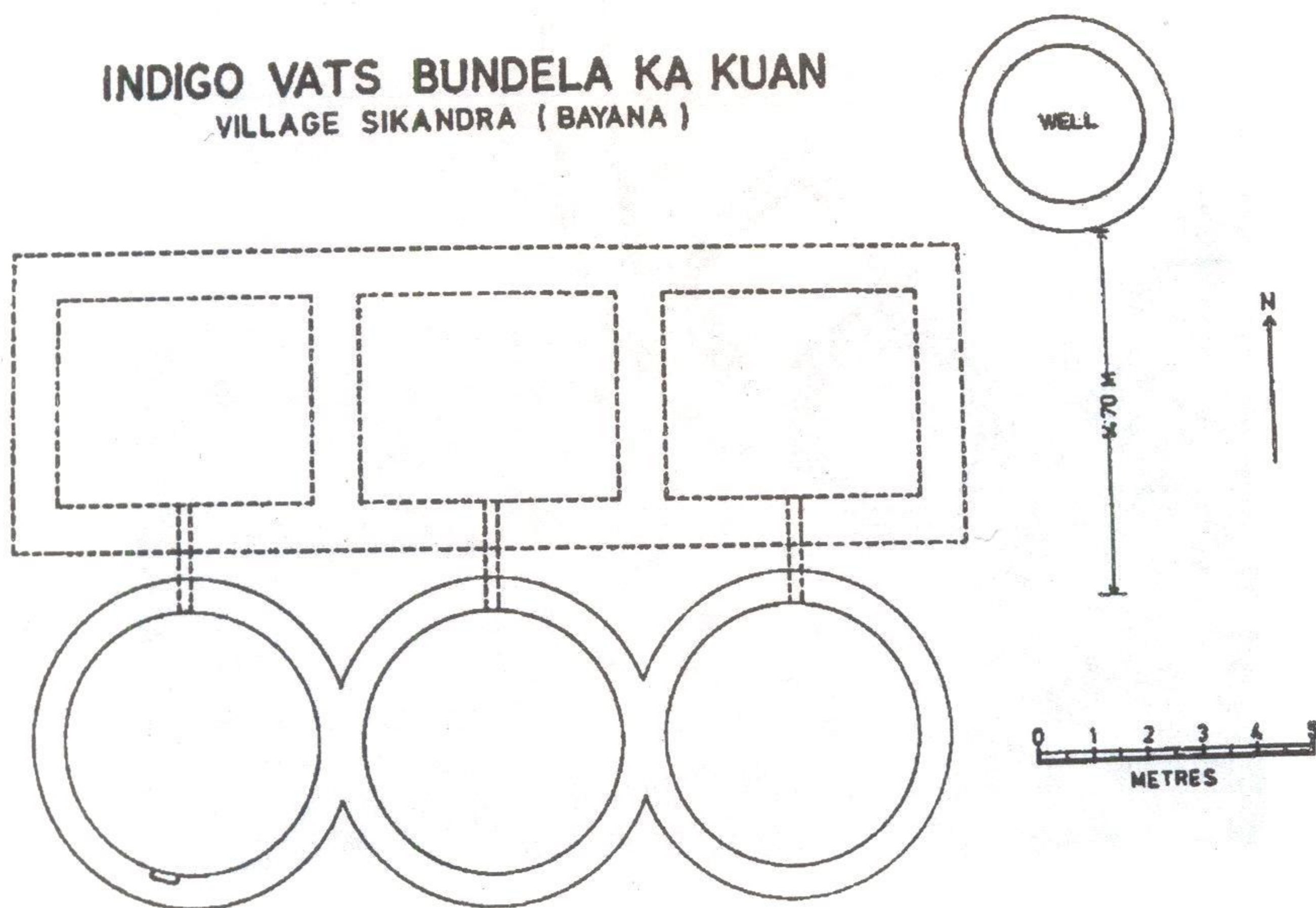


## Vats in Village Brahmabad



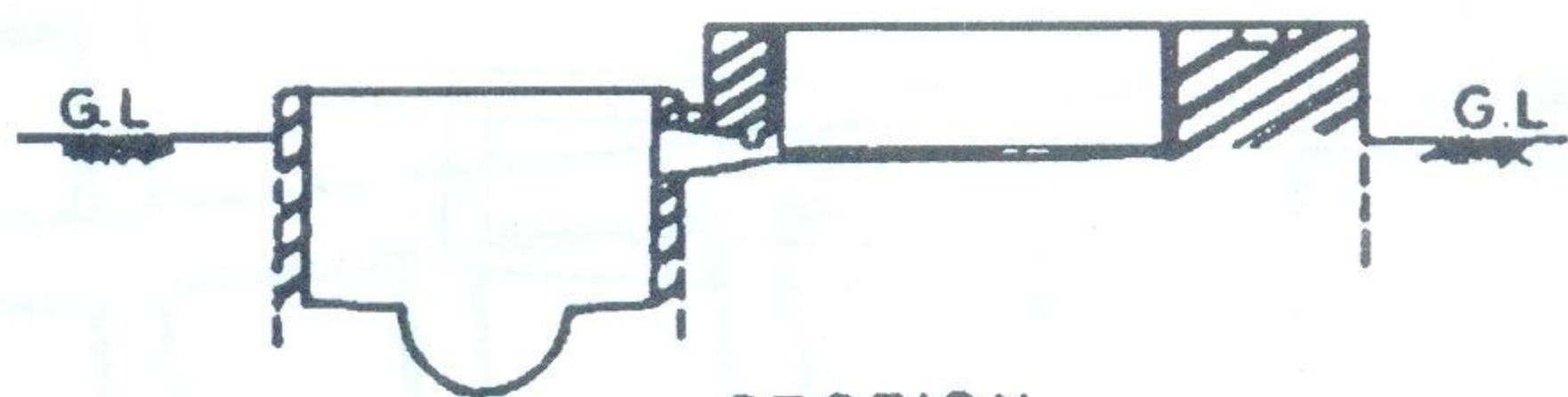
## Vats in Village Wer

### INDIGO VATS BUNDELA KA KUAN VILLAGE SIKANDRA (BAYANA)



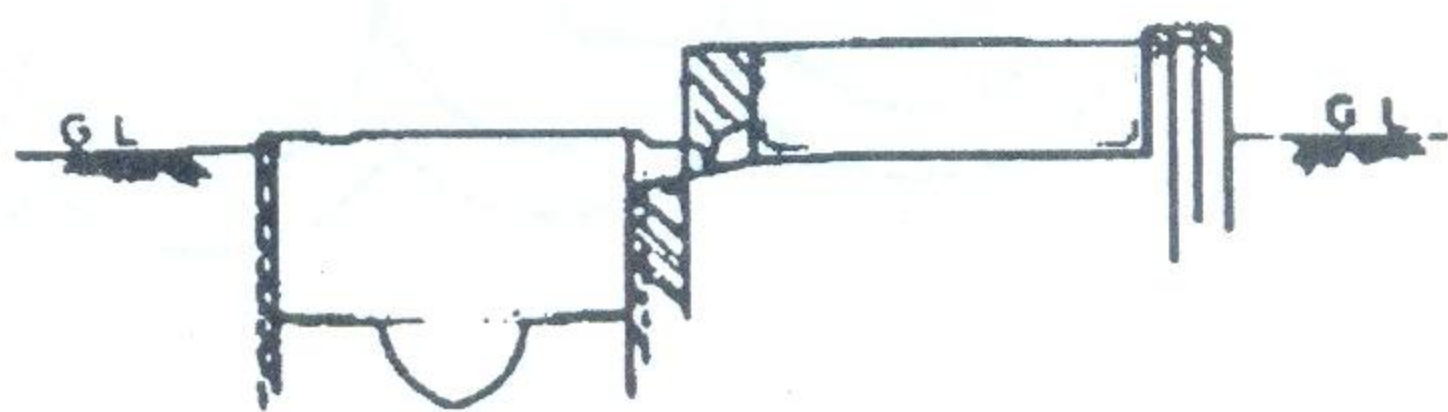


# Indigo Vats Jalali: Elevations



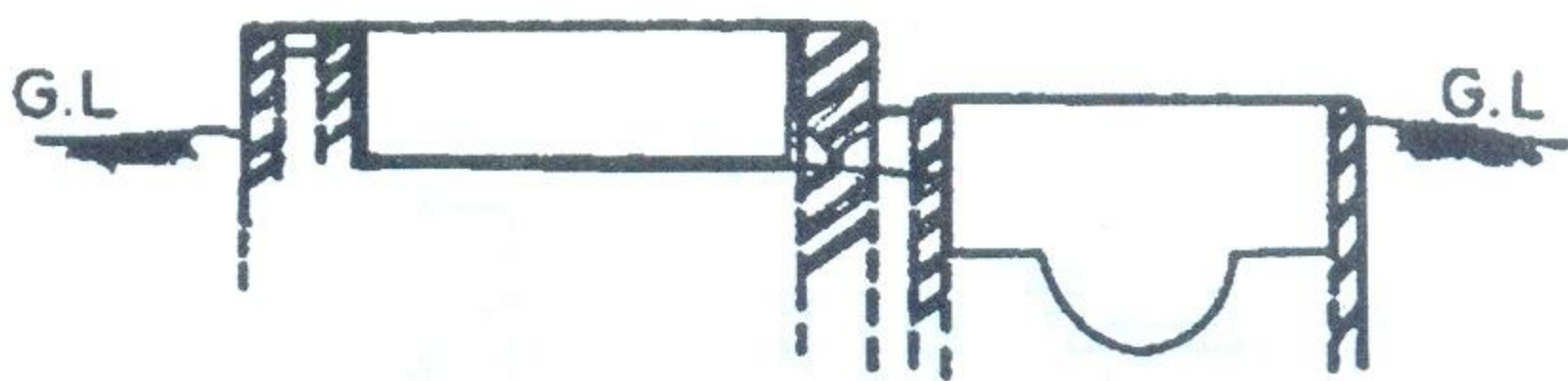
SECTION

Vats near Sibtain Miyan ka Bagh



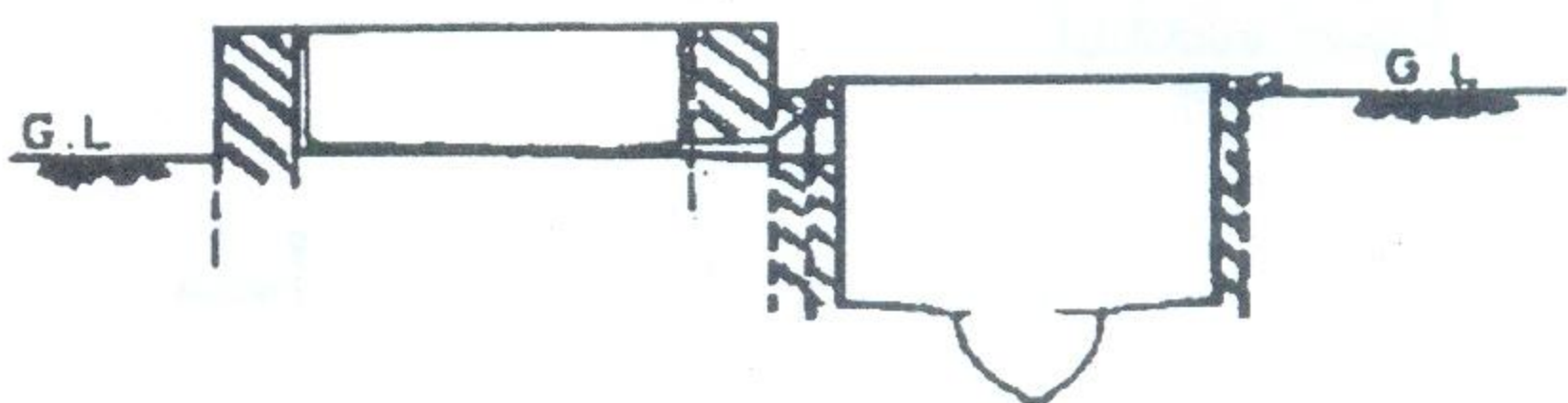
SECTION

Vats in Jaddi ka Bagh



SECTION

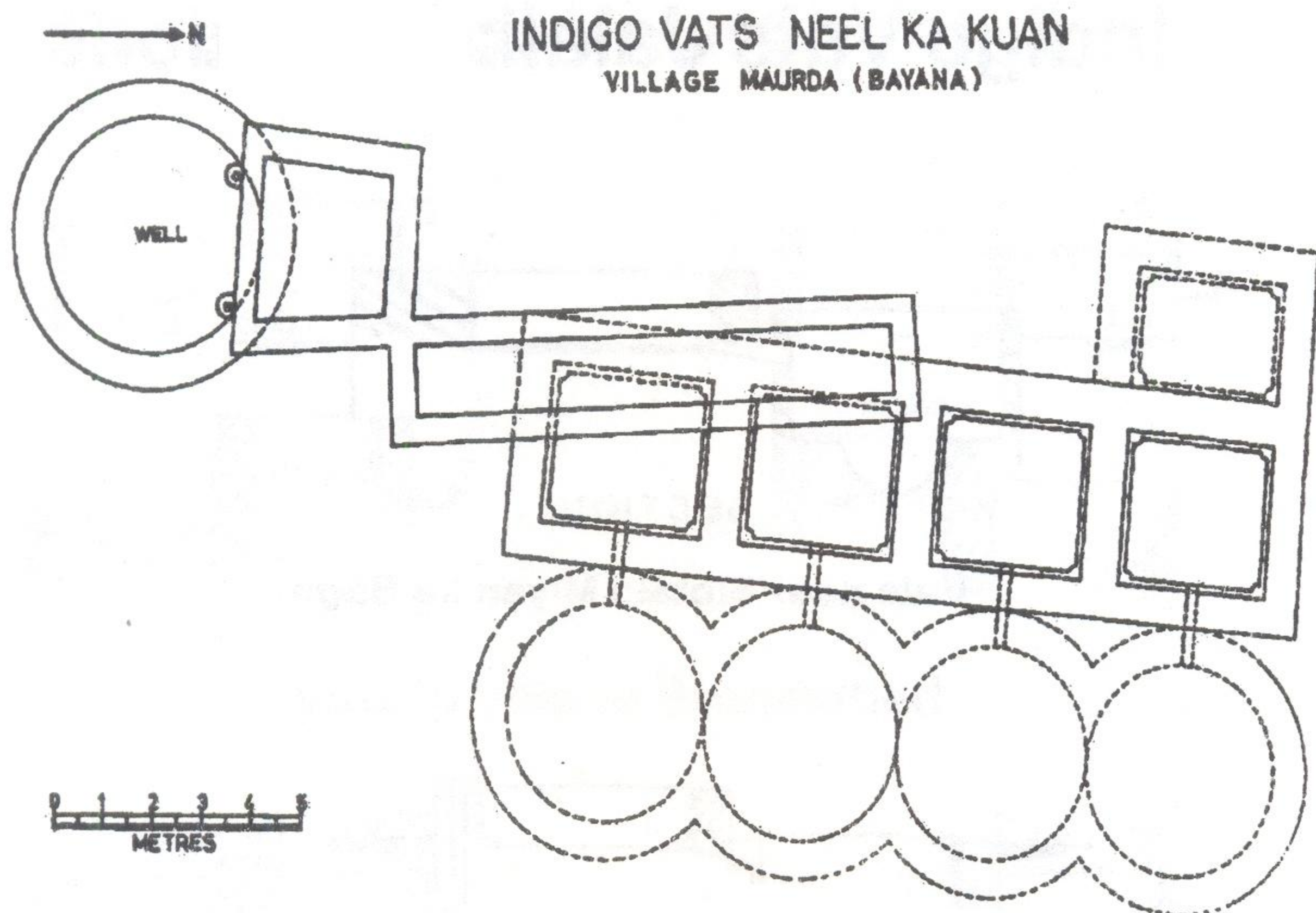
Vat in Parshadi ka Bagh



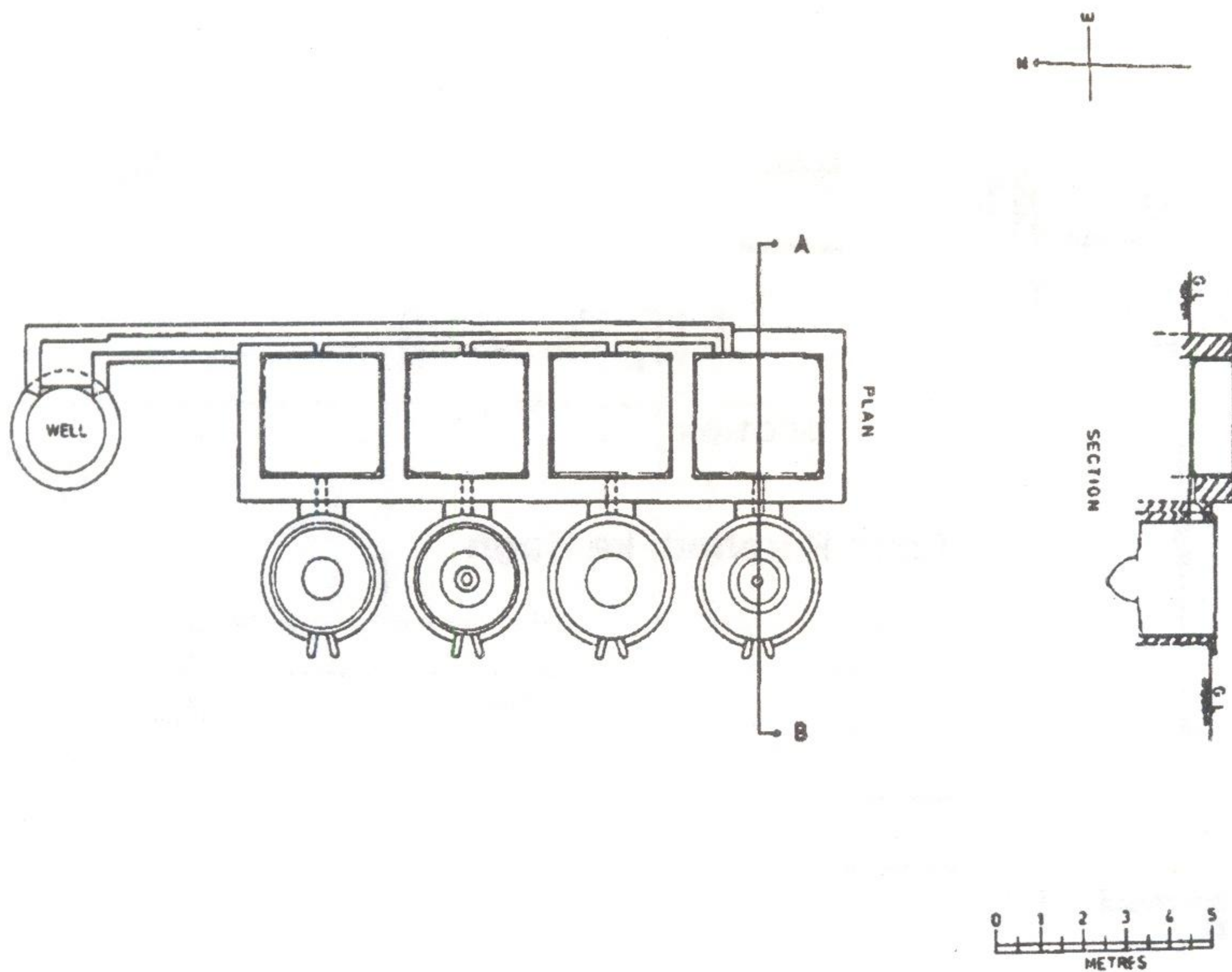
SECTION

Vats at Gadhi Naddi

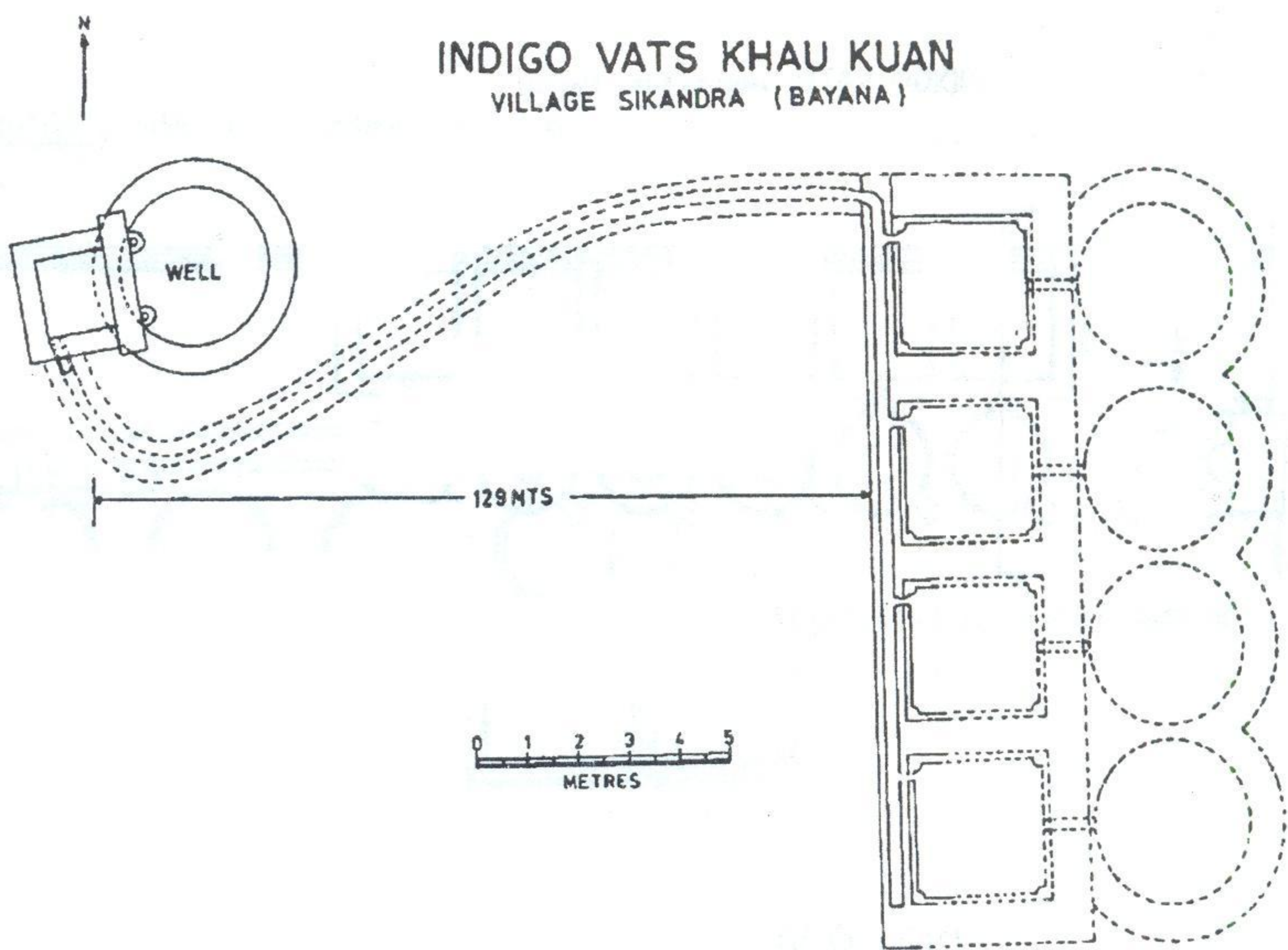




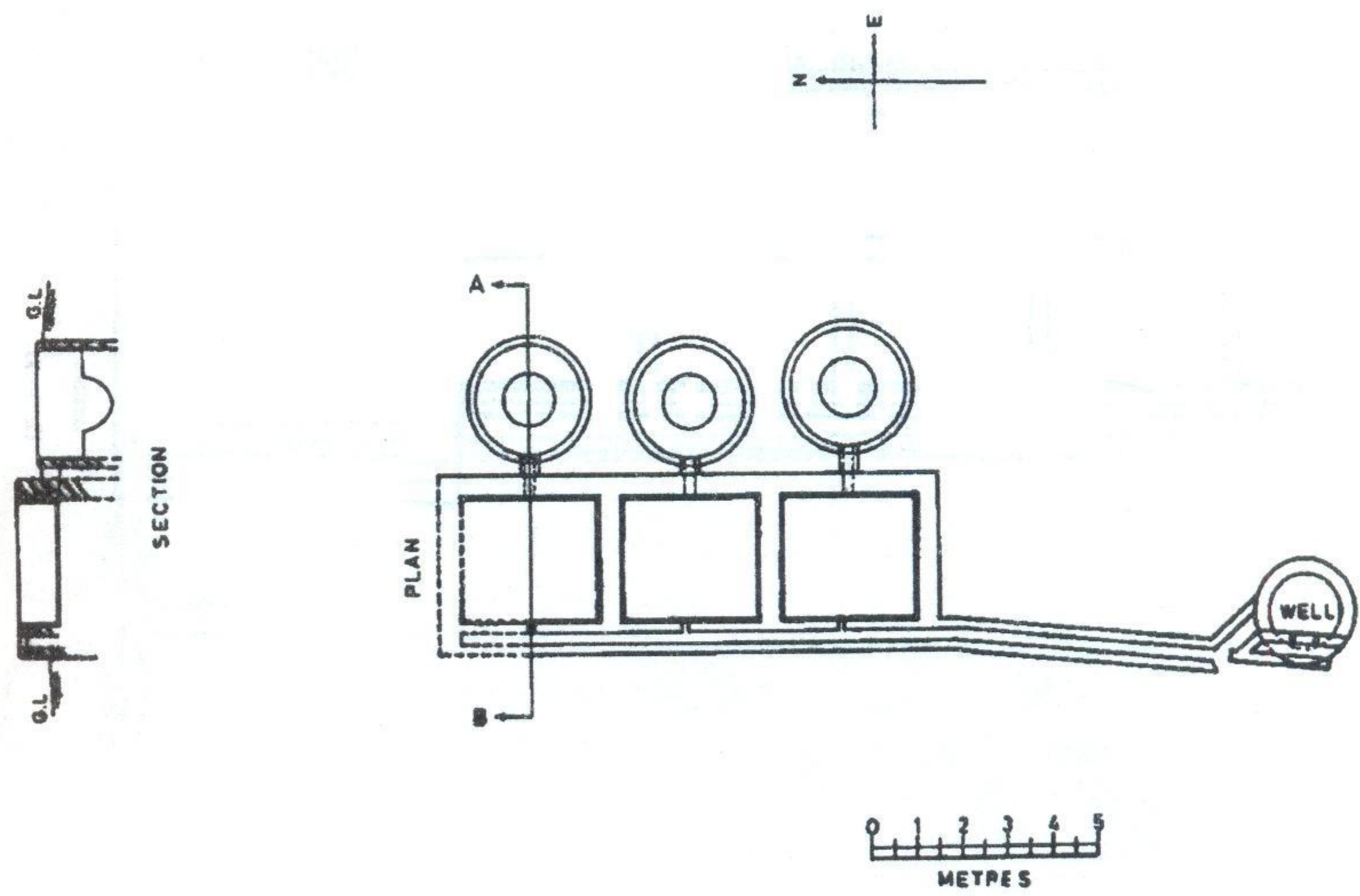
**INDIGO VATS GARHI NADDI (JALALI)**



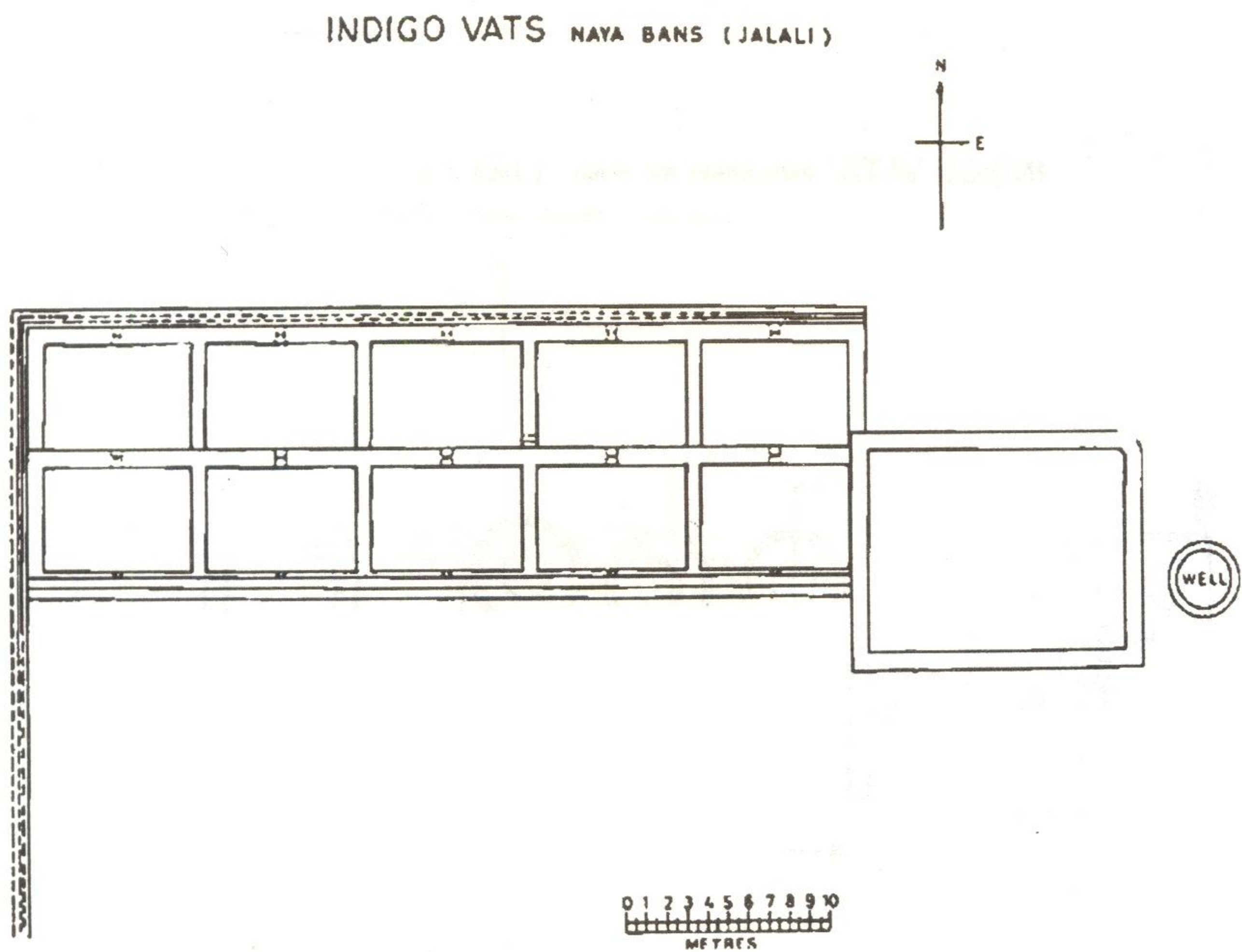
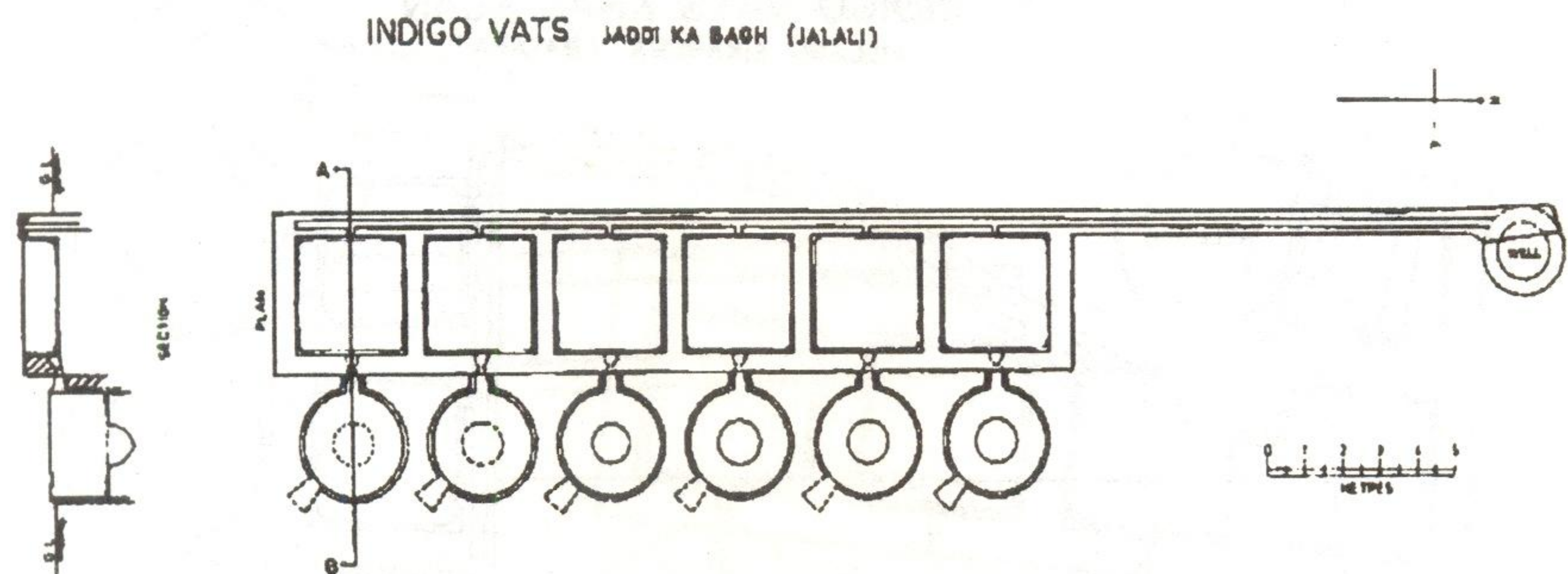




**INDIGO VATS PARASHADI KA BAGH ( JALALI )**

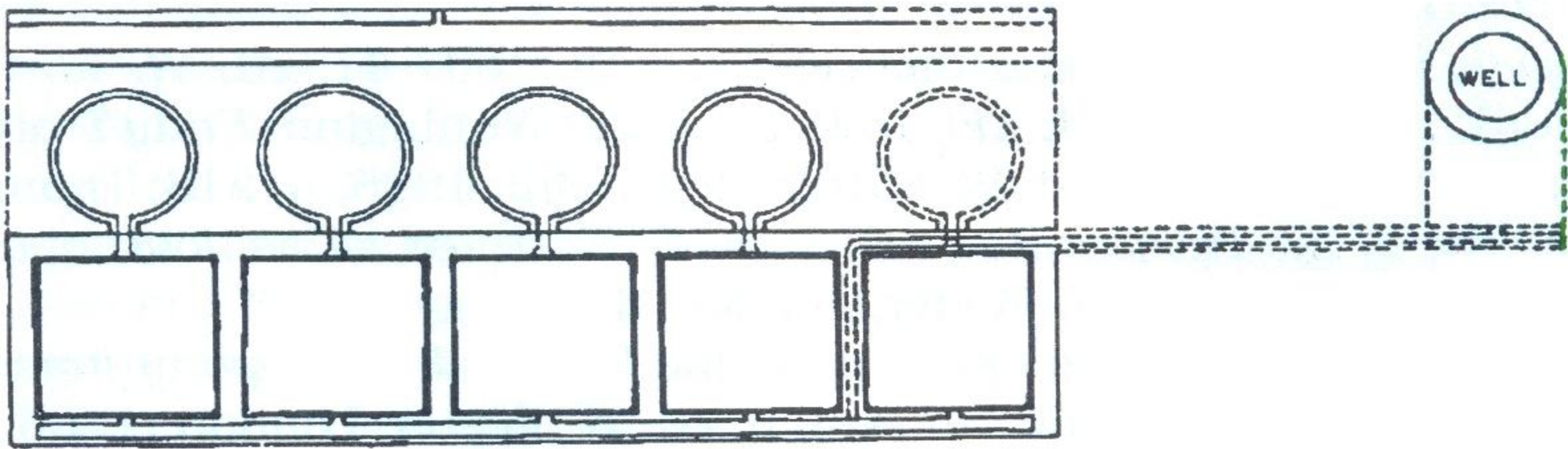




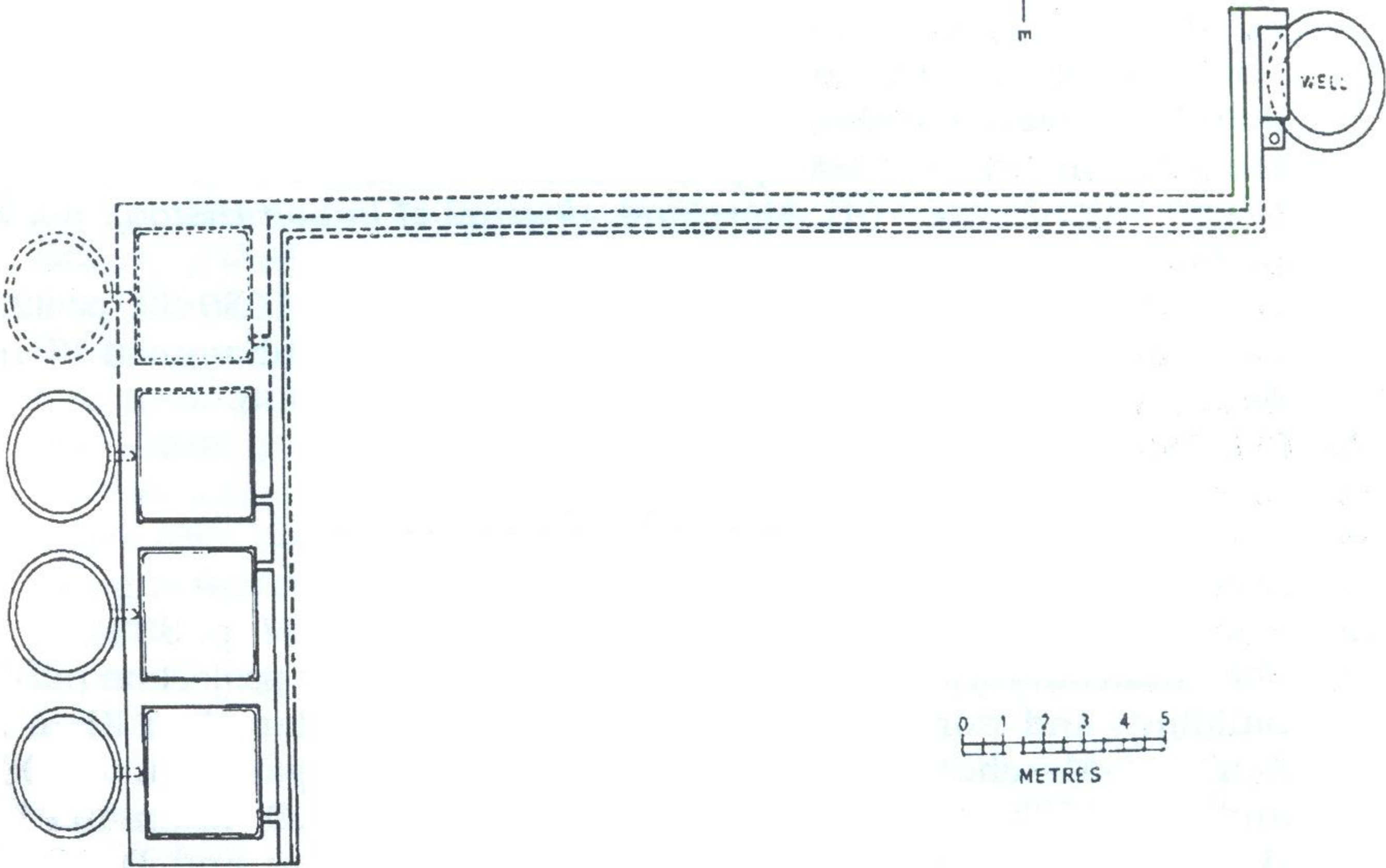




INDIGO VATS      IDGAH    ( JALALI )



INDIGO VATS    YASIN WALA KUA    BADAN AREA    ( JALALI )





## References

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3. See for example *Letters Received by the East India Company from its Servants in the East, 1602-17*, vol. II, ed. W. Foster, London, 1896, p. 102; *EFI*, 1665-67, p. 164; 'Relations' of Methwold and Schorer in *Relations of Golconda in the Early Seventeenth Century*, ed. & tr. W.H. Moreland, Hakluyt Society, London, 1931, pp. 35-36, 61.
4. Jean-Baptiste Tavernier, *Travels in India, 1640-67*, tr. V. Ball, 2nd ed. W. Crooke, Vol. II, New Delhi, 1977, pp. 7-8.
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7. Pelsaert. op. cit., p.15; Mundy, op.cit., p. 96; *EFI*, 1630-33, p. 325; for Khurja as an important indigo mart, see Ali Muhammad Khan, *Mirat-i Ahmadi*, ed. Nawab Ali, Baroda, 1930, I, p. 408.
8. *EFI*, 1630-33. p. 325.
9. Tavernier, op. cit., II, p. 7.
10. *EFI*, 1646-50, p. 219.
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12. Watt. *Dictionary of Economic Products of India*, Vol. IV, p. 393.
13. The initial surveys were conducted as part of a larger project on public buildings and works undertaken by Professor Iqtidar Alam Khan in February-March 1985 and then April 1986 at Bayana; June 1984 and May 1985 at Jalali, district Aligarh. Late Dr. I.G. Khan and Dr. B.L. Bhadani accompanied Prof. Khan to Bayana; and Dr. S. A. Nadeem Rezavi accompanied him to Jalali. The photographs were taken by late Mr. Saaedul Hasan and the plans were made by Mr.



Zameer Ahmad, both of the Centre of Advanced Study, department of History, AMU. Explorations at Shahpur kothi, Madrak (dist. Aligarh), Sa'adabad (dist. Mathura) on the Aligarh-Agra road, and Khurja, on the other hand, were conducted by Dr. S. Ali Nadeem Rezavi in March 1997 and then in November 2007. Late Mr. Rajiv Sharma accompanied the team in its explorations at Madrak and Khurja. The authors would like to extend their thanks to all those who were part of their teams in the various explorations and surveys over the years.

14. A sub-division of District Bharatpur in the state of Rajasthan, India. Headquarter of this sub-division also known as Bayana is situated in 26°53' N. and 77°19'E. There are three *tehsils* within Bayana sub-division: (1) Bayana, (2) Wer, (3) Rupbas.
15. Iqtidar Alam Khan, "Pre-Modern Indigo Vats of Bayana", *Environmental Design : The Garden as a City The City as a Garden*, The Journal of the Islamic Environmental Design Research Centre, ed. Attilio Petruccioli, 1989, pp. 92-98; See also K.K. Trivedi, "Innovation and Change in Indigo Production in Bayana, Eastern Rajasthan", *Studies in History*, Vol. 10, no.1, new series, 1994, pp. 53-80.
16. John Huyghen van Linschoten, *Voyages of John Huyghen van Linschoten to the East Indies*, ed. A.C. Burnell (vol. I), and P.A. Tiele (vol. II), Hakluyt Society, London, 1885, (reprint New Delhi & Madras, 1988), vol. II, p. 91.
17. John Albert de Mandelslo, in J.B. Harris, *A Collection of Travels*, London, 1735, pp. 83-84 Cf. JN Sarkar, *Studies in Economic Life in Mughal India*, Delhi, 1975, p. 135; Geleynssen de Jongh, *Remonstratie van W. Geleynssen de-Jongh's*, Gravenhage, 1929, p. 47 Cf. Ishrat Alam, "New Light on Indigo Production Technology during the sixteenth and seventeenth Centuries", *Art and Culture, Felicitation Volume in Honour of Professor Nurul Hasan*, ed. AJ Qaisar & SP Verma, Publication Scheme, Jaipur, 1993, pp. 119-28.
18. The Voyage of M. Joseph Salbancke through India, Persia, Part of Turkie, the Persian-Gulfe, and Arabia, 1609. Written unto Sir Thomas Smith', *Hakluytus Posthumus or Purchas His Pilgrimes, Contayning a History of the World in Sea Voyages and Home Travelles by Englishmen and Others*, by Samuel Purchas, vol. III, Glasgow, 1885, p. 84.
19. Pelsaert, op.cit., p.15; for Bayana see also Finch, op.cit., p.153; *Letters Received*, IV, p. 241. It is interesting to note that Mundy while discussing the making of indigo in the Agra region, including Bayana mentions and describes only one set of tanks, however his account starts with the words 'there is also Tancks called...' alluding to there being something more than what he describes. See Mundy, op.cit., p. 222.
20. Tavernier, op. cit., II, pp. 8-9.
21. Mundy, II, p. 222.
22. *EFI*, 1646-50, p. 219; for similar comments on Mewat indigo made in single vats, see Pelsaert, op.cit., p. 15.
23. For the use of this term see also Mundy, op.cit., II, p. 222.
24. Finch, op.cit., p. 153; *Letters Received*, IV, p. 241; Pelsaert, op.cit., p.10; Mundy, op.cit., II, p. 222.



25. Mundy, II, 222; Tavernier mentions the tanks made of lime, 'so hard that one would say they were made of a single piece of marble', see Tavenier, op.cit., II, pp. 8-9.
26. Pelsaert, p. 10.
27. Ibid.
28. Finch, p. 153.
29. Finch, p. 153; Pelsaert, p. 10.
30. Pelsaert, p. 10.
31. Finch, p. 153.
32. For mixing of the oils, see the report of Francis Fettiplace from Agra to the Governor and committee, dated 26 November, 1616, *Letters Received*, IV, p. 241.
33. *Letter Received*, IV, p. 35.
34. Tavernier, II, 8-9.
35. Pelsaert, 11.
36. Ibid.
37. Finch, p. 153-54; Pelsaert, p. 10.
38. All these sites are situated within Bayana sub-division. Of them only Wer (situated in 27°1'N. and 77°11'E.) is a *tehsil* headquarter. We wish to acknowledge the keen interest evinced by Mr B.D. Yadav, the then S.D.O., Bayana, during our survey.
39. All these sites are located in areas around the Jalali settlement, 27°55'N and 48°15'E.
40. Photograph no. 2 : "A close-up of the vats located near Nil Ka Kuan at Wer". In this photograph a part of the first circular tank from the west, the entire stretch of the northern parapet of the rectangular tanks and the northern extremity of the channel facilitating the flow of liquid from the rectangular tank to the circular tank of the first vat from the west, are clearly visible.
41. For details see Iqtidar Alam Khan, "Pre-Modern Indigo Vats", op.cit.
42. See attached section plans of Bayana and Jalali vats. The Madrak circular vats could not unfortunately be cleared to make their study possible.
43. Cf. Vertical sections shown along with the layout drawings of vats at Wer and Brahmbad.
44. See Plans of Brahmbad vats.
45. See the drawings depicting the vertical sections of some of the vats at Brahmbad and Wer.
46. Pelsaert, p. 10.